Supplementary Material

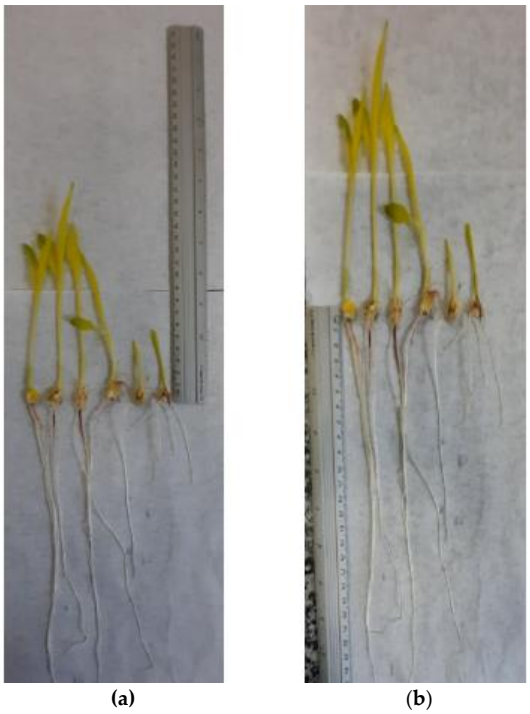
Humic Substance Recovery from Reverse Osmosis Concentrate of a Landfill Leachate Treatment via Nanofiltration

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Figure S1. Detail of the membrane after permeation



(a) (**b**)

Figure S2. (a) Evaluation of Air Part Length (APL) and (b) Primary Root Length (PRL) using a ruler.



(a) (b)



(c)

Figure S3. Photos of (a) original RO concentrate (feed), (b) NF permeate and (c) NF concentrate.

Table S1. Characterization of the feed, permeate, and concentrate from nanofiltration. Conditions: applied pressure: 9 bar; operation time: 20 hours; Volume Reduction Factor (VRF): 2.5; the NF NADIR membrane, model NP010.

Parameter	Feed	Concentrate	Permeate
Abs 254 nm (dimensionless)	208.5	315.5	102.8
TOC (mgC/L)	7564	11,433	3239
Cl^- (mgCl/L)	13,161	10,811	12,691
Color (mgPtCo/L)	18,571	58,095	1905
COD (mgO_2/L)	32,872	48,820	13,832
NH_3-N (mg/L)	10,539	8167	8367
pH	7.9	8.2	8.4
Turbidity (NTU)	65.5	57.0	4.6
Humic Substances (mg/L)	19,671	29,763	9698

Table S2. Calculation details of mass balance during NF process

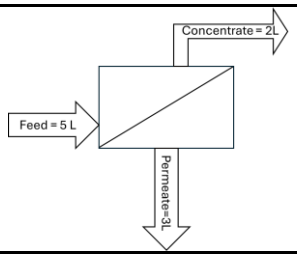
Volume of streams (VRF=2.5)				
Parameter	**Mass (%)**			
	Feed	**Permeate**	**Concentrate**	**Membrane adsorption**
TOC	100	25.7	60.5	13.8
COD	100	25.2	59.4	15.4
Humic Substances	100	29.6	60.5	9.9
Chloride	100	57.9	32.9	9.2

Table S3. Key findings of the present study

Category	**Description / Study results**
Membrane Specifications	
Model	NF NADIR NP010
Material	Polietersulfona (PES)
MWCO	1000 Da
Typical rejection	35–75% (Na_2SO_4)
Mode of operation	Bench-scale membrane module, 77.7 cm^2
Operating parameters	
Pressure	9 bar
Feed flow rate	120 L/h
Initial volume	5 L de ROC
Operation time	20 h
Temperature	25 °C
FRV	2.5
Initial permeate flow	34.8 $L/m^2 \cdot h$
Final permeate flow	≈30 $L/m^2 \cdot h$
Cleaning	NaOH → H_2SO_4 → SDBS
Nanofiltration results	
Organic Matter concentration in concentrate	70–75%
TOC (concentrate)	29,763 mg/L
COD (concentrate)	48,820 mg/L
HS (concentrate)	11,433 mg/L
Agronomic Application – Germination	
Concentrations tested	20–100 mg HS/L
Germination Index Results	>100%
Best performance	20 mg/L (GI = 167%)
Metals in the product	Under CONAMA 357/2005